Regional and Global Energy System Modelling with focus on China

Mischke, Peggy

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Peggy Mischke, Systems Analysis Group, Denmark Technical University

Email: **peym@dtu.dk**

Challenge – An improved understanding China´s regional energy systems and its global impacts

China is at the centre of an unprecedented shift in the global economy and the global energy industry. Over the past decades China has experienced fast economic growth, accompanied by rapid urbanization, increasing energy consumption, widening regional disparities and soaring green house gas emissions.

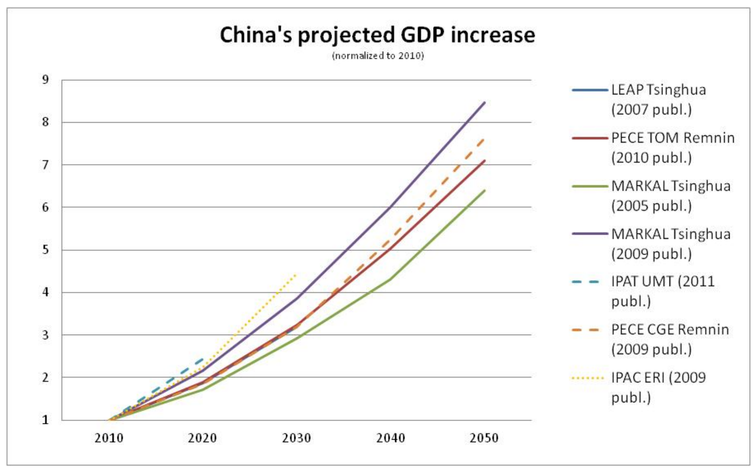
This remarkable growth has led to twin challenges for China: (i) improving environmental sustainability and regional economic development and (ii) enhancing energy security. Furthermore it is recognized that any major effort to minimize, mitigate and adapt to the adverse effects of climate change will need to better understand and integrate China´s future energy system pathways and related policy targets.

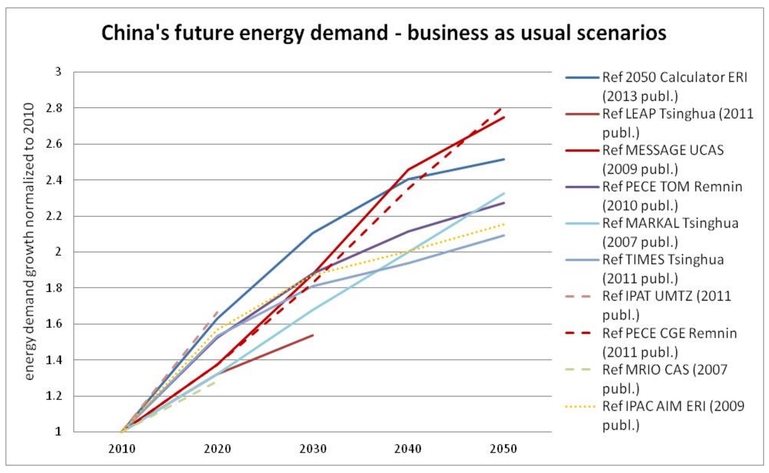
Insights from a China – A comparison of modeling results for China´s future energy system development - accomplished

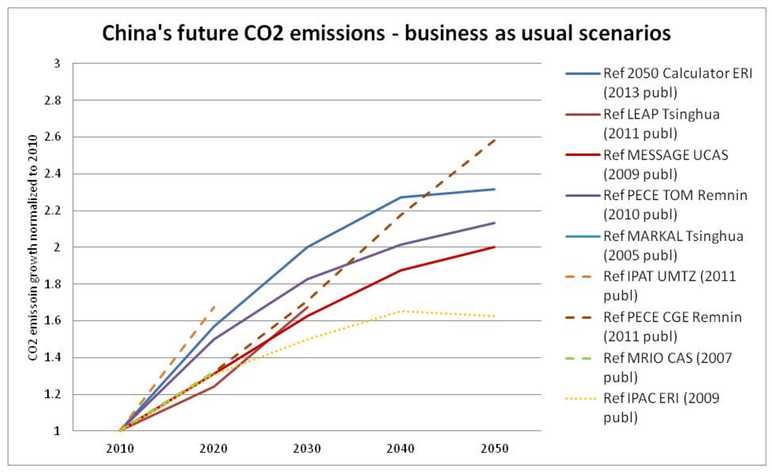
The modelling structure, application areas, results and conclusions from 17 different mathematical modelling tools developed by various Chinese institutions were reviewed and compared to evaluate China's future energy system development from a Chinese perspective. A growing number of Chinese modelling tools is accessible in English language in academic journals and research reports since 2005, among them many bottom up and top down models and one hybrid tool. Only a few of those models are currently represented in international model comparison studies and international research projects.

Research highlights indicate the following:

- The preferred application areas of the reviewed modelling tools are the economic impacts of energy and climate policies (including GDP loss) and the identification of optimal technologies for China's future power system.
- The policy recommendations in the reviewed modelling studies can be summarized as a gradual and long term transition of China's energy system, with a likely CO2 emission stabilization period after 2030 depending on the applied energy and climate policy mix.
- The review and comparison of the modelling results suggests that a transition from China's coal dominated energy system to a low carbon growth model would include mainly energy efficiency improvements, CCS deployment and increased nuclear power generation.

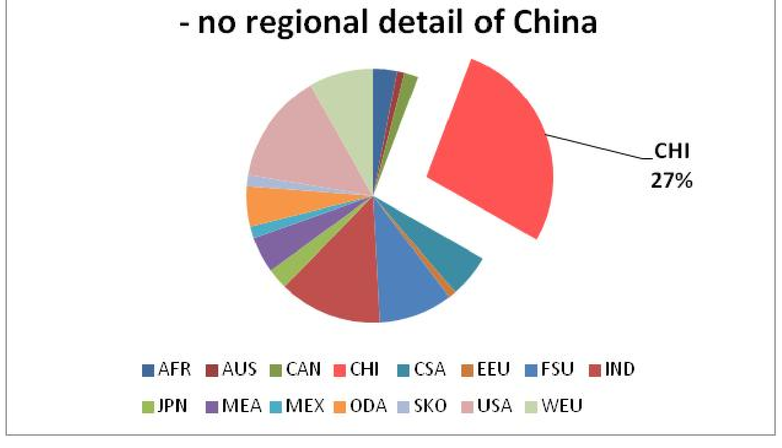


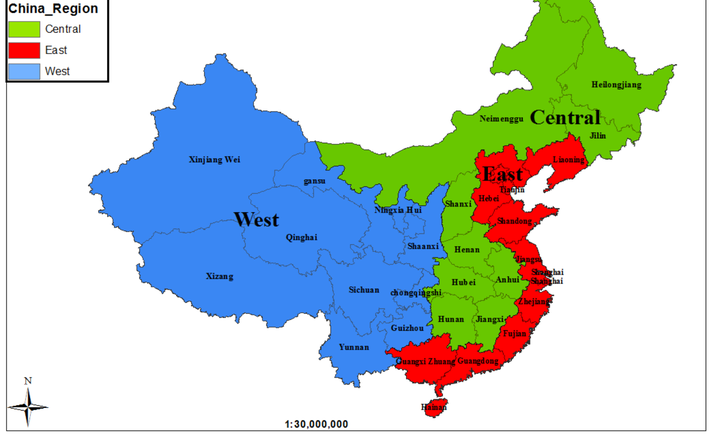


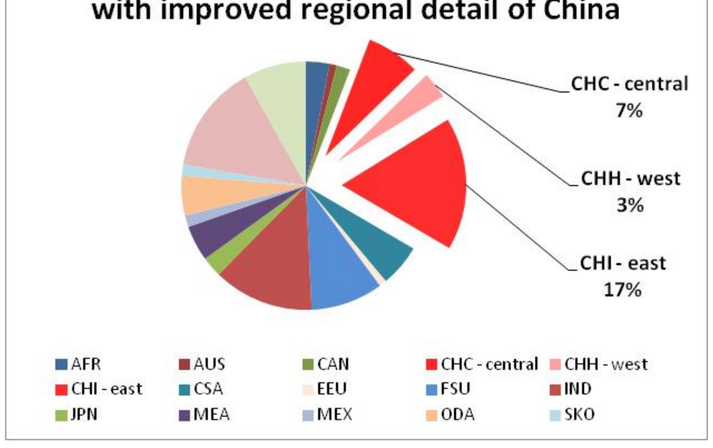


Methodology – Modelling different economic regions of China inside a global bottom up energy modelling tool - in progress

Integrated energy system assessment modelling is well suited for analysing complex energy system developments, natural resource uses, energy sector policies, and energy related international trade. The PhD research builds on global bottom up energy system models, such as the TIMES Integrated Assessment Model (TIAM), an economic model generator supported by the International Energy Agency. TIAM provides a technology-rich basis for estimating energy dynamics over a long-term time horizon, where equilibrium of energy markets is found via maximization of total surplus in different world regions.







Expected results – Supporting policies and decision making processes – in progress

The PHD research will define a regional specific China energy system model, building on regional aspects of China´s energy system and related drivers, and link it to an integrated global energy system assessment model. This will be followed by extensive scenario exploration to assess technological options and costs of energy and climate policies in the course of the long term development of China´s energy system in a global perspective. While taking into account multiple assumptions, policy objectives and constraints, the research is expected to support future energy policies and decision making processes.

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